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# MILO AS A DRY-LAND GRAIN CROP.

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# LETTER OF TRANSMITTAL

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
*Washington, D. C., April 3, 1908.*

Sir: In connection with the regular work of the Office of Grain Investigations conducted for the past five years on experimental farms and at other points in the Southwest, much success has been attained in the improvement of grain sorghums, particularly in the production of dwarf strains of milo characterized by good seed production and erect heads. It appears that much of this information is sufficiently definite and of such a practical nature as to make it of immediate benefit to the many farmers who are now settling in the semiarid plains, particularly as milo is one of the most satisfactory dry-land crops that can be employed. This matter has been brought together in the accompanying manuscript by Mr. Carleton R. Ball, Agronomist in Charge of Grain Sorghum Investigations, and Mr. Arthur H. Leidigh, Superintendent of the Amarillo Experimental Farm, Amarillo, Tex., and I would recommend its publication as a Farmers' Bulletin.

Respectfully,

B. T. Galloway,
*Chief of Bureau.*

Hon. James Wilson,
*Secretary of Agriculture.*

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B. P. I.—367.

# MILO AS A DRY-LAND GRAIN CROP.

## WHAT MILO IS.

### RELATIONSHIPS AND CLASSIFICATION.

The sorghums [a] grown in this country may be separated into four groups: (1) Broom corns; (2) sorgos, or sweet sorghums; (3) kafirs, and (4) durras. The broom corns are grown only for their brush, the sorgos for forage and sirup, the kafirs for grain and forage, and the durras almost exclusively for grain.

Milo (fig. 1) belongs to the durra group, which contains also white durra ("Jerusalem corn," "rice corn," "white Egyptian corn") and

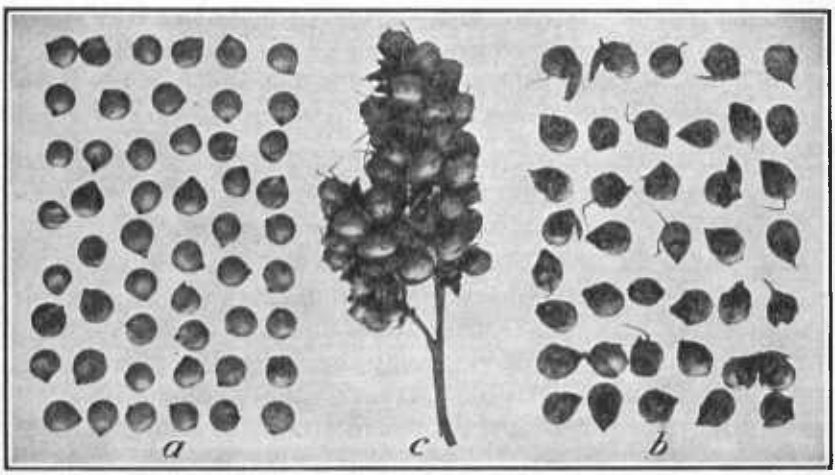


FIG. 1.—Seeds of milo. *a*, cleaned seed; *b*, seed in hulls; *c*, small branch of head, showing awns on spikelets. (Natural size.)

brown durra ("brown Egyptian corn"). The durras are characterized by dry and rather pithy stems and large, oval or egg-shaped, mostly pendent ("goose-necked") heads. The number of leaves on

[a] For further information as to the sorghums, the reader is referred to the following Farmers' Bulletins, which will be sent free upon receipt of a request addressed to the Secretary of Agriculture: No. 135, "Sorghum Sirup Manufacture"; No. 174, "Broom Corn"; No. 246, "Saccharine Sorghums for Forage"; No. 288, "The Nonsaccharine Sorghums."

each stalk is only 8 to 10 on the average. This scanty foliage and the pithy stems make them of little value for forage compared with kafirs and sorgos. The seeds of the durras are larger than those of the kafirs and sorgos, are nearly circular in outline, and are usually somewhat flattened.

The chief varieties of the durra group may be separated as follows:

Seeds white; hulls pale; flower awned.....White durra.
Seeds reddish brown; hulls pale; flower not awned.....Brown durra.
Seeds pale yellowish; hulls dark; flower awned (fig. 1).....Milo.

## ORIGIN AND INTRODUCTION.

Milo was introduced into the United States between 1880 and 1885 and was first grown in South Carolina or Georgia. It came probably from Africa, but this is not certainly known. No sorghum brought since from Africa has been exactly like milo, though one found in Egypt and called there durra safra, or yellow durra, is quite similar to it.

Milo was first widely advertised and sold by the M. W. Johnson Seed Company, of Atlanta, Ga., in the spring of 1887. It soon became distributed over the South and as far west as Texas. In western Texas, and especially in the Panhandle region, it has become popular and widely grown because of its drought resistance and comparative earliness.

## COMMON NAMES.

Milo was first known as "Yellow Millo Maize." The adjective "yellow" was applied because of the yellowish color of the seeds and because a white-seeded sorghum, related to the kafirs, was then being sold and grown as "White Millo Maize." Many other names have since been applied to milo. Among them are Branching doura, Dwarf milo, Dwarf milo maize, Dwarf yellow milo, Millo, Millo maize, Milo maize, Red Egyptian corn, Rural branching sorghum, Yellow branching dhoura, Yellow branching millo maize, Yellow branching sorghum, Yellow millo maize, Yellow milo, and Yellow milo maize. Several of these names are occasionally applied to brown durra also. Dwarf milo, Yellow milo, and Milo "maize" are the names most commonly used for milo.

The name "milo" is adopted and recommended because it is short, distinctive, and appropriate. The word "maize" should never be used for milo, as it confuses this crop with corn.

## VARIETIES.

There is only one well-marked variety of milo yet offered for sale by seedsmen. It is usually sold as "yellow milo" or "yellow milo

maize." What is commonly sold as "dwarf milo" is the ordinary milo grown on the dry and elevated plains of western Texas, Oklahoma, and Kansas, where it reaches a height of 4½ to 5½ feet. It is thus dwarfed because of the conditions under which it is grown. When its seed is carried to lower and more humid districts the crop grows to a height of from 7 to 10 feet, according to the conditions of soil and moisture. On the other hand, seed from this lowland crop if taken to the high plains will produce only the dwarfed crop 4½ to 6 feet tall. The ordinary "yellow" milo and the "dwarf" milo of commerce represent, therefore, one and the same thing, which is discussed in this bulletin simply as milo.

The only true "dwarf" milo known to the writers was secured a few years ago from Judge J. F. Bradley, of Memphis, Tex., who states that the original seed was brought from Oklahoma. So far as known, this dwarf strain (see fig. 4) is not yet handled by seedsmen. It is described later in the paragraph on the characters of improved milo. The so-called "giant milo" occasionally met with in the Plains region consists of hybrids of milo with other sorghum varieties, usually kafirs or sorgos.

### CHARACTERS OF ORDINARY MILO.

When first introduced milo (fig. 2) was suitable for use only as a general forage crop. Owing to its small and scanty leaves and pithy stems it was inferior to kafirs and sorgos for forage purposes. On the western plains it began to be developed as a combined grain and forage crop. Like all sorghums it was strongly drought resistant. Compared with some other grain varieties of sorghum it was only fairly early and productive, but it possessed good seed-holding power, which white durra ("Jerusalem corn") and brown durra sadly lacked. From the standpoint of grain production it had, besides these desirable characters, several very objectionable habits. These were (1) the abundant stooling, (2) the free branching, (3) the size and height of the stem, and (4) the pendent, or "goose-necked," heads. (See fig. 6.)

Why are these four habits objectionable in a grain variety?

Stooling (1) and branching (2) prevent uniformity of height and of ripening. In sorghums the suckers comprising the stool from a single main stalk do not all develop at one time. In the same way the branches appear successively rather than all at once, beginning at the second node from the top and progressing downward. These suckers and branches produce heads which ripen at different dates, but none of them as early as the main heads. These branches and suckers are also of different heights, some higher and some lower than the main stalks. Uniform height and ripening are very neces-

sary in a grain crop. The habit of suckering and branching must therefore be checked by selection.

The size and height of the stems (3) make hand cutting difficult and heading by machinery almost impossible.

The pendent heads (4), hanging downward (see fig. 2) from the apex of the recurved peduncle or stem, are an especial nuisance. Their position not only prevents the use of headers in harvesting the seed crop but makes it very difficult to handle the heads satisfactorily

FIG. 2.—Field of the ordinary unselected milo, from 6 to 7½ feet tall, with stout, branched stems and pendent heads.

in any way. They are in an awkward and dangerous position to cut by hand. The curved stem is likewise objectionable. It prevents the stalks from lying parallel when cut. It makes the tops of bundles wider than the bottoms, thus forming shocks that can neither withstand winds nor turn water. The crook of the stem is always interlocking with adjacent stems, so that they can scarcely be separated in field or shock.

Such were the characters of the original milo and such is in large measure the unimproved crop to-day.

## CHARACTERS OF IMPROVED MILO.

In the past four or five years the development of milo as a grain crop has been progressing rapidly along the lines just shown to be desirable. The carefully selected milo (fig. 3) of to-day is a great improvement over the common, unselected crop. Ordinary milo has been reduced by selection to a uniform height of 4 to 4½ feet in the Plains regions lying at an elevation of 3,000 to 4,000 feet above sea level, or at an equivalent latitude. Through selection and thicker

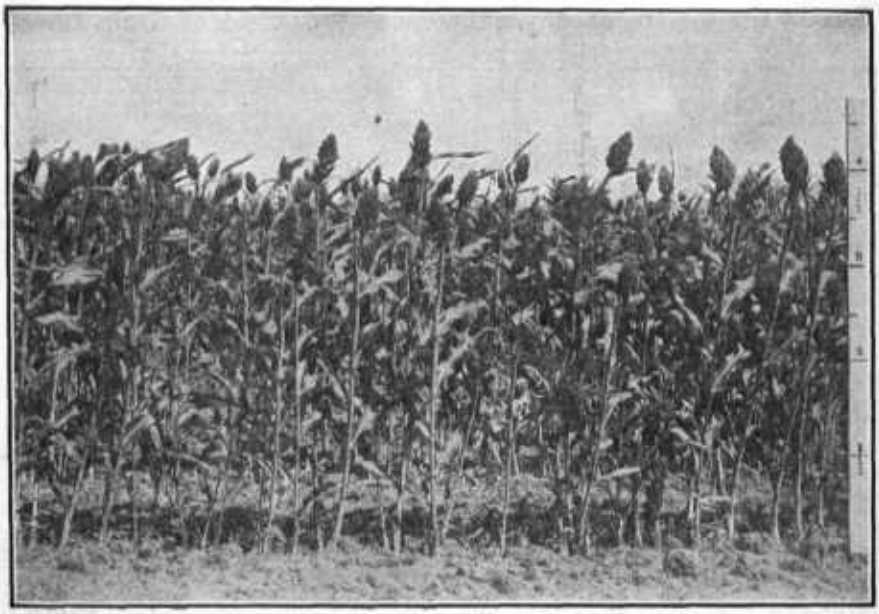

FIG. 3.—Field of milo as improved by selection, from 4 to 4½ feet tall, slender, without branches, heads erect.

seeding the heads have been changed from mostly pendent to mostly erect. All heads not leaning over more than 30 degrees from the perpendicular (see fig. 7) are classed as erect, since for all practical purposes they are erect. From 75 to 90 per cent have been brought to this position in different strains. A large part of the remaining 10 to 25 per cent are merely inclined, i. e., bent over more than 30 degrees and less than 90 degrees, or the horizontal position. These inclined heads would be readily gathered by a header. Only a very small percentage of the heads are pendent, i. e., declined below the horizontal line.

By the combined influences of selection and thicker seeding, branching has been almost entirely prevented, and stooling, or the produc-

tion of suckers, has been greatly checked. About one-fourth to one-half the plants produce no suckers at all, and most of the remainder produce only one sucker on each plant. Earliness has been increased until these strains ripen in ninety to one hundred or one hundred and ten days under the conditions of altitude and climate found in western Texas and adjacent territory. The grain yields of the crop have been maintained and increased during all these changes in habit.

A true dwarf strain (fig. 4), growing only 3 to 3½ feet in height under the same conditions as the ordinary taller strain, has been improved in the same way as the ordinary milo, though the changes are not yet quite as firmly fixed.

All the work of selection and improvement here outlined has been done by the writers, under the direction of the Office of Grain Inves-

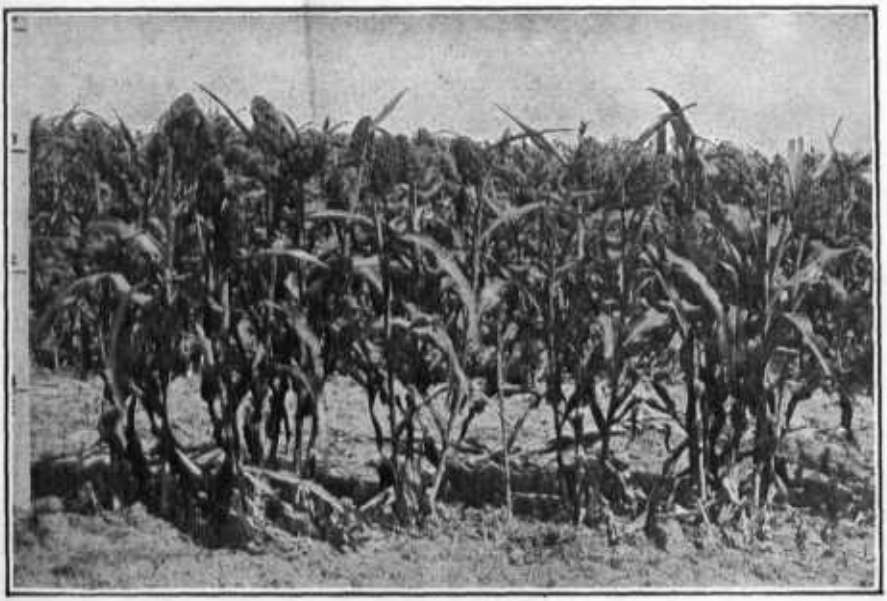

FIG. 4.—Field of the true dwarf form of milo, from 3 to 3½ feet high.

tigations. Most of it has been carried on at the experimental farms maintained by the office mentioned, formerly at Channing, Tex., and now at Amarillo, Tex. These improved strains are not yet generally on the market, but are gradually finding their way to the seedsmen and probably will soon be obtainable by everyone interested.

## WHERE TO GROW MILO.

Milo is at present the most successful summer grain crop for the southern half of the Plains region. It is an earlier and more drought-resistant crop than corn and makes a satisfactory feeding

substitute. The highest average yields of corn under the same conditions have been ten bushels to the acre less than those of milo. The yields of blackhull kafir have been five bushels less to the acre.

Milo is now a staple crop in a large part of western Texas and in the adjacent portions of New Mexico, Colorado, Kansas, and Oklahoma. This section lies at elevations of 1,500 to 4,000 feet above sea level and has a varying annual rainfall of 17 to 25 inches. Milo is well adapted to the whole southern half of the Plains region lying below an elevation of about 4,500 feet.

Milo can be grown successfully on the lower plains of eastern Oklahoma, eastern Kansas, and southern Nebraska, where kafir varieties are now the leading grain sorghums. In this eastern sec-

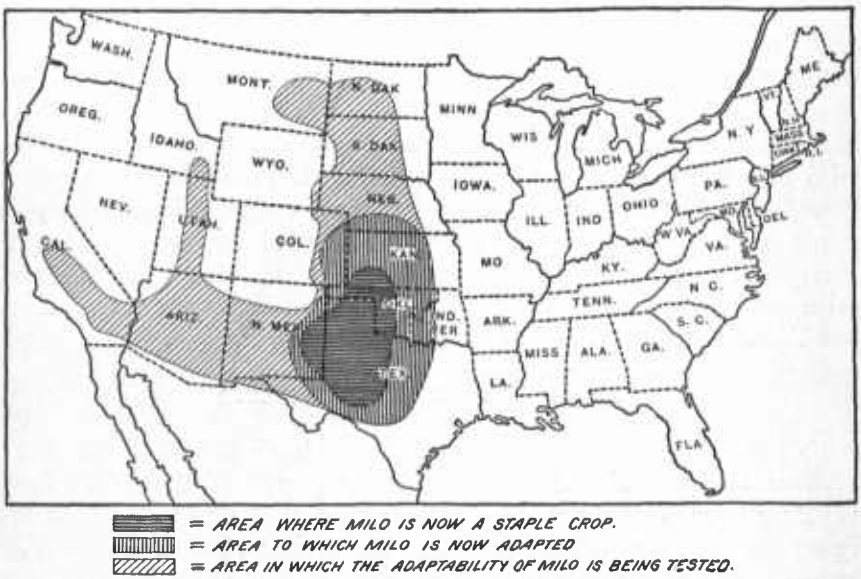


FIG. 5.—Map of the United States, showing where milo is or may be grown.

tion of the plains corn is ordinarily a profitable crop, and the acreage of milo will depend on seasonable variations. In dry years milo should be largely grown there, but in wet years it will be replaced by corn to a considerable extent.

It seems very probable that the limits of successful production of milo can be rapidly extended northward and westward from the present area. The accompanying map (fig. 5) shows (1) the area where milo is now a staple crop, (2) the area to which milo is now well adapted, and (3) the area in which milo is being thoroughly tested and in much of which it will probably be grown successfully.

In 1907 milo was ripened at several points in eastern Colorado at elevations of 5,500 to 6,000 feet. It was fully matured at the agricultural experiment substation at North Platte, in western Nebraska.

At the experiment substation at Highmore, in central South Dakota, at an elevation of 2,000 feet, in latitude 44° north, the earliest milo was just ripe when frost occurred, on September 26, 1907.

Early strains of milo will be thoroughly tested in 1908 over all the northern Plains region and throughout the Great Basin or intermountain area as well. Farmers ripening milo outside the limits of present production should very carefully select their seed from hardy and early-maturing plants, thus founding a strain suited to their conditions.

Milo is not adapted to humid regions and should not be grown in them.

## HOW TO GROW MILO.

### SOILS.

The soil requirements for milo are about the same as those for corn. Well-worked sandy loams or clay loams are best. Light sands and heavy clays are much less desirable. The roots penetrate to depths of 3 to 4 feet in ordinary friable soils. Fair yields result on rather poor lands; better yields in good soils. In the semiarid country much depends, however, on the way the soil is handled to conserve moisture. Early and deep plowing to catch and hold the rainfall when it comes, with surface cultivation to keep down weeds and prevent evaporation, are the two principal lines of treatment possible.[a]

### PREPARING THE SEED BED.

Fall plowing is preferable to spring plowing where it can be done, because it increases the water-absorbing power of the soil. Deep plowing is better than shallow plowing for the same reason and because it encourages deeper rooting. Harrowing should be thorough before sowing to mellow the soil for the seed bed and to destroy any weeds that may have started. Increased labor in preparing a field before sowing is almost always well repaid by an increased yield of the crop.

On sandy soils or other soils which blow about in windy weather, fall disking and medium-deep spring plowing may be required. When the lister is used, disking in the fall or early spring is advised or double listing may be practiced. Milo usually makes a fair crop on fresh sod and in the semiarid regions is thought to be the best crop for spring-broken sod land. The seed is dropped in every third

[a] For a full discussion of this subject the reader is referred to Farmers' Bulletin No. 266, by George H. Failyer, entitled "Management of Soils to Conserve Moisture, with Special Reference to Semiarid Conditions." This bulletin may be obtained by application to the Secretary of Agriculture, Washington, D. C., or to any Senator or Representative in Congress.

or fourth furrow while breaking and covered by the next sod turned or is planted with a shoe drill. The crop thus sown can not usually be cultivated.

## PLANTING THE SEED.

It should be remembered that the following directions for planting, especially those concerning the rate and the manner of sowing, are for growing milo as a grain crop. Those who are familiar with handling this and other sorghums as forage crops should note the difference required in the rate of seeding and in other practices.

### Time of Planting.

The time to plant varies, of course, with the latitude and altitude. In general, milo should be sown about two to four weeks later than the average date for planting corn. The average date will therefore vary from about April 15 in southern Texas and the lower Southwest to about May 25 on the higher plains of northwest Texas, and to about June 1 to 15 in Nebraska and South Dakota. Because of its earlier maturity, milo can be planted later than the varieties of kafir wherever they are safe crops. Milo should not be sown until all danger of spring frost is past and the soil has become warm.

### Methods of Planting.

Milo may be either listed or surface planted, as the experience in any particular locality has shown to be the best for crops of this class. Listing is a common practice in much of the Plains region where milo is now, or is likely to become, a staple crop. Certain advantages are secured from listing. The young plants are protected from the strong winds of spring and from the cutting action of sand carried by such winds, which sometimes cuts the stems of surface-grown crops entirely off. The root systems of listed crops are also said to lie deeper, because of the deeper sowing, but this fact is doubtful, owing to the later growth of surface roots. On the other hand, listing tends to make the crop ripen later because the young plants at the bottom of the furrow grow more slowly than those planted at the surface. In wet seasons the lister furrow fills with water and the young crop may be either washed out or covered up with sand or mud.

Surface sowing is the rule in a large part of the milo country and will probably increase in importance as a method of sowing even in sections where listing is now generally practiced, since better methods of conserving soil moisture are becoming understood.

Whether listed or surface sown the most common way of sowing milo is by means of special sorghum plates used in the corn planter or lister planter.

### Rate of Planting.

For the highest yields of grain from 4 to 6 pounds of seed to the acre is sufficient if the seed is of good quality. Milo is usually sown in rows 3½ feet apart; sometimes only 3 feet apart. The quantity of seed used will vary somewhat with differences in soil and climate. Sections with rich soils and more abundant moisture can sow milo more thickly in the row than sections having thin sandy soils and lighter rainfall. Several years' tests on the experimental farm of the Office of Grain Investigations, at Amarillo, in the northern part of the Texas Panhandle, show that one plant to every six inches of row gives the highest grain yields under the average conditions obtaining there. The soil on this farm is a good clay loam, the elevation is 3,600 feet above sea level, and the average annual rainfall about 22 inches. Four pounds of seed to the acre produce under these field conditions plants averaging 6 to 8 inches apart—the desired stand. Thicker stands than this have generally been recommended for grain production but are not desirable under Panhandle conditions.

These figures are intended to be suggestive rather than final. A series of experiments covering three or four different rates of seeding must be carried on for several years at different points in the milo belt before the question of how much to sow to the acre can be fully settled. The best rate may prove to be different for each different set of conditions of soil, moisture, and length of growing season. It will also be dependent to a considerable extent on the cultivation given. Until these facts are more fully known, each farmer should test for himself two or three different rates of seeding. Four pounds, six pounds, and eight pounds of seed to the acre are suggested for such trials.

Where the plate on the planter can be set to run at different speeds only one plate will be required for planting seed at different rates to the acre. The proper speed to use for each desired rate can be ascertained by testing the planter on a floor or smooth, hard piece of ground. The distance at which the seeds are dropped can then be very readily observed and the proper distance secured. Where the speed of the plate can not be changed, several plates with different numbers of holes will be necessary to secure different rates of planting. Each hole should be large enough to drop two small seeds at once, but not two medium-sized or large ones. The holes should be countersunk well on the under side of the plate. The number of holes required in the plates in order to drop seeds 3, or 6, or 8 inches apart, respectively, can readily be figured out for each kind of planter, the holes then drilled by the farmer or a blacksmith, and the results tested as described above.

In general, thick sowing produces small stalks and small, erect heads, but many more heads on an acre. Thin seeding makes larger stalks and larger heads, but fewer of them. Thin sowing also produces a larger number of the objectionable pendent heads.

### CULTIVATING THE CROP.

The cultivation of milo is much like that of corn. Milo, like all sorghums, grows slowly at first and may become choked by weeds on foul land unless care is taken. The harrow or the weeder should be freely used in such cases, running in the same direction as the rows. This applies both to listed and to surface-sown crops. When the plants are sufficiently large, any ordinary style of cultivator may be used. The various special tools for cultivating young listed crops are well adapted for use with milo. The earliest cultivation may be deep if desired, but after the root system has filled the space between the rows, cultivation should not be more than 2½ to 4 inches deep. Such shallow tillage does not injure the roots and keeps the surface in fine tilth, thus conserving moisture by preventing evaporation.

### SELECTING AND SAVING SEED.

In the case of a new crop, like milo, it is very desirable that each farmer select carefully his own seed. This is especially true of the farmer who is outside the present milo region. If he is at a greater elevation, or at a more northern latitude, or in a more arid district than that of the principal milo belt, good home-grown seed will be best for his sowing. Selected seed will also be much better than ordinary bulk seed, even from his own fields.

As previously noted, the most important points for which milo is being selected are (1) earliness, (2) drought resistance, (3) productiveness, (4) uniform height and ripening, (5) freedom from branches and suckers, and (6) erect heads. (Figs. 6 and 7.)

Selections for any or all of these points must be made in the field instead of after the crop is harvested. Except for earliness and uniform ripening, the selecting may be done any time before harvest. Wherever earliness is an important point, the selecting must be done when the earliest heads are maturing, since later, when all have ripened, the early heads can no longer be distinguished from later ripening ones.

Selections should, if possible, be made in a part of the field where the stand is good and other conditions are the average. There is always a temptation to select where the stand is thin because of the fine large heads produced in such spots. In selecting for productiveness, or high yields, stalks should be chosen having the largest and

heaviest heads where the stand is fairly thick. Erect, early-ripening heads on stalks of equal and average height, free from suckers and branches, should be selected and plainly marked in the field. Marking may be done by means of a pasteboard tag, a bit of white cloth, or a piece of white paper securely tied to the stalk just below the head. If tied so that it can flutter in the breeze, so much the better, as it will be easier to find the heads when they are to be gathered. The heads should be left on the stalks in the field until fully ripe, when they may be gathered by hand and hung up to a rafter or on

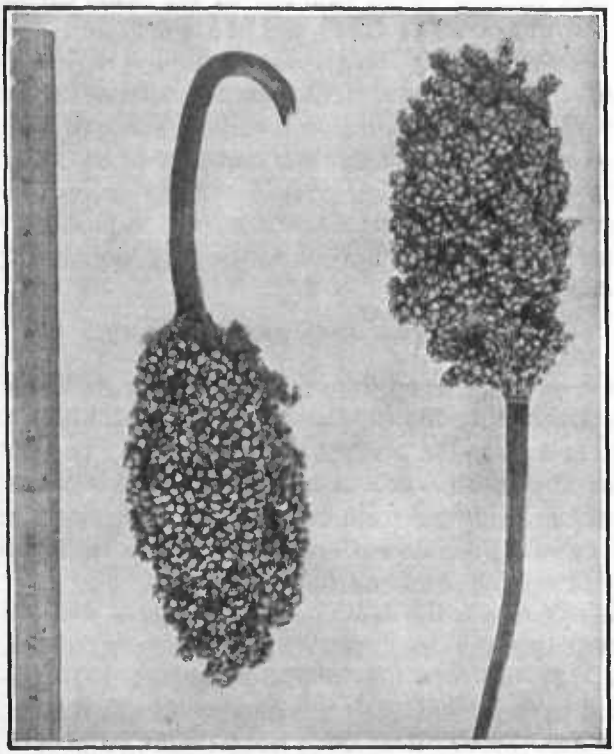

FIG. 6.—Milo heads; one pendent, one erect.

the wall of the granary or toolhouse to dry. They may be laid on a shelf in a well-ventilated room if the layer of heads is not made too thick, but should not be hung in a stable, as the moisture is likely to injure the seed. They may be allowed to hang all winter and be thrashed out in early spring. Before planting time the seed should be tested for germination.[a]

[a] For a simple method of testing the germination of seeds the reader is referred to Farmers' Bulletin No. 111 (p. 21), which may be secured on application to any Member or Delegate in Congress or to the Secretary of Agriculture.

Any farmer who feels that he can not spare the time to select enough seed for sowing his entire field of milo for the succeeding season can at least select enough to sow an acre or more to be used as a seed plat. Forty or fifty heads will be quite sufficient for an acre. Good results may often be obtained by placing the work of selection in the charge of a bright boy. Help him to get in mind the desirable type of plant and interest him in improving the crop. Some premium might be given him if his selected seed plat outyields the unselected field.

## HARVESTING THE CROP.

Where sown as suggested milo is usually harvested with a corn binder and cured in the shock (fig. 8). In ordinary milo the recurved stems and pendent heads make the bundles so large at the top that shocks made from them are not firm, but are easily blown over by wind and wet by rain. Our improved strains, with heads mostly erect, are not open to these objections. When milo is bound with either the corn binder or grain binder, the heads may be cut from the bundles with a broadax or a heavy knife hung at the tip. The crop may also be thrashed without heading, or it may be fed in the bundle without thrashing.

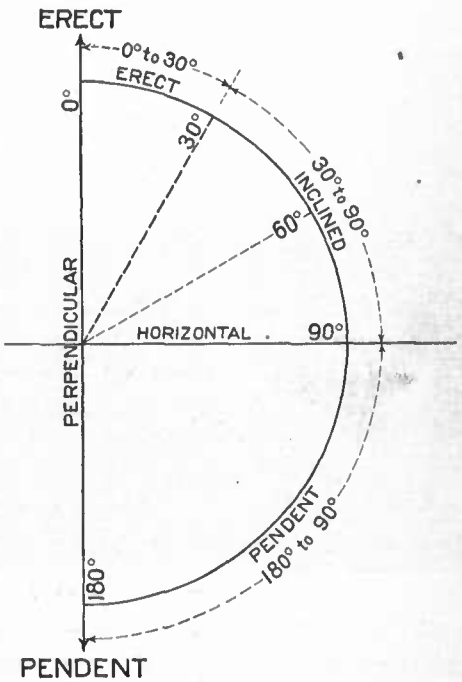


FIG. 7.—Diagram showing named positions of heads of milo.

Heading the crop in the field is naturally the most desirable method of harvesting, since it saves handling the stover and makes thrashing easier and more rapid. Ordinary milo, with pendent heads, can not be successfully harvested with any kind of header. The improved strains are adapted to harvesting with the row header, the grain header, or with either binder. A suitable type of row header is very much needed for harvesting all forms of grain sorghums.

Some machines of this kind are in use to a limited extent for heading kafir varieties. These machines (fig. 9) are built for attachment

to the wagon box. As at present made, they can not be adjusted to a large enough variation in the height of the crop. They also harvest but a single row at a time. It is likely that in regions where wheat headers are in use they will be utilized to head the milo also. This can readily be done where the crop is not more than 4 feet in height and the heads are erect.

Heretofore it has been a common custom to cut the heads from the stalks in the field by hand, especially on small areas. Owing to the pendent position of the heads in the unimproved crop, this is a slow, difficult, and often dangerous method. It would hardly be profitable on a large scale with either crop.

Milo may be harvested by any method as soon as ripe. It is the common custom in northwest Texas to allow milo to stand for some

FIG. 8.—Field of milo in shock, Channing, Tex.

weeks after it is ripe before cutting it. Where the crop is to be thrashed, this matters little, but where the milo is to be fed in the bundle it is a wasteful practice. The leaves, always scanty, are dried out, break off in the wind, and are lost. The stems become hard, woody, and unpalatable. The feeding value of such stover is much lowered. It is not at all necessary to so treat the crop. The stems of milo are naturally dry and pithy, and so ripen nearly as early as the heads, which is not true in the stouter and more juicy kafirs. When it is to be cured in the shock and fed in the bundle it may be cut as soon as the seed is in the hard dough stage.

### THRASHING THE SEED.

Thrashing is readily done in an ordinary grain separator. To avoid cracking a considerable proportion of the seed, the concaves

may be replaced with boards or part of the concave and cylinder teeth removed. The speed of the cylinder should also be reduced to about 600 revolutions a minute. Where the thrashed seed is intended for feeding to stock, there is no objection if much of it has been cracked in thrashing. In fact, milo is usually cracked or ground before being fed to stock, because otherwise much of it passes through the cattle without being digested. But where intended for use as seed grain it is, of course, worthless if cracked. Where it is desired to thrash shocked milo, the heads may be cut from the bundles as suggested or the bundle may be held in the cylinder until the grain

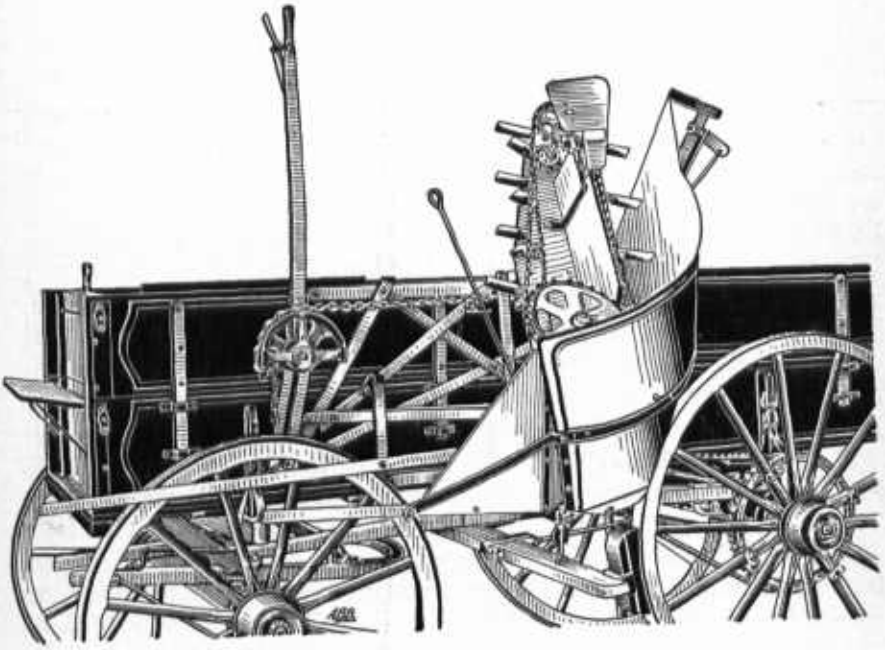

FIG. 9.—A form of row header used for kafir varieties.

is all removed from the heads and then thrown to one side. It is scarcely profitable to thrash the whole bundle, though this is commonly done.

## YIELDS OF GRAIN.

The yields obtained at the Amarillo and other experimental farms of the Office of Grain Investigations during the past five years have averaged almost exactly 40 bushels of milo to the acre. The highest has been 46 bushels. Yields of 30 to 55 bushels are reported by farmers. The seeds when of good quality weigh fully 60 pounds to the bushel. The limits of yield have probably not been reached and the average is likely to increase as the crop becomes more carefully selected and more intelligently handled.

## HOW TO USE MILO.

### FEEDING ON THE FARM.

The principal use of milo on the farm will be as a feeding grain,[a] similar to corn. Chemical analyses show that the seeds of corn and milo are nearly identical in composition. Whether their feeding values are as nearly equal is not certainly known. No accurate experiments have been made to determine this fact. Experiments made with the grain of kafir varieties prove them to be a little less valuable than corn for feeding purposes. Milo is equal to or somewhat better than the kafirs as a feeding grain. Unlike kafirs, milo has a beneficial laxative effect on the bowels.

More and more milo is being fed as a thrashed grain. To prevent waste by imperfect digestion, it is best to crack or grind the milo before feeding. Where hogs follow cattle, the waste in feeding whole grain is reduced, but the cattle will do better on the cracked than on the whole grain. The grain, like corn, gives the best results when fed with some other feed containing more protein, such as alfalfa, cotton seed, or cowpea hay.

Where milo is headed in the field or from the shock, the heads may be fed whole, or they may be ground and fed, or they may be thrashed and the grain fed. The whole heads are readily ground in any large feed mill, though thrashing first and then grinding the seed is said to require no more power.

A considerable amount of milo is fed in the bundle, especially in localities where little grain is grown and separators are not common. This is a fairly satisfactory way of handling the crop, provided the stand is fairly thick and it is cut as soon as ripe, before the stalks become bare and woody. When feeding milo in the bundle, care should be taken that no more is placed in the feed racks than is eaten each day. Stock will not thrive where their ration becomes moldy or much mussed over in the racks. Many cases of "blind staggers" and other sickness have been directly traced to feeding such moldy foodstuffs.

### SELLING THE GRAIN.

There is now a growing market for milo grain. Apparently, increasing quantities are being used in poultry foods and in chops.

[a] The only feeding test with milo of which the writers have knowledge is reported in a circular issued by the Texas Agricultural Experiment Station, entitled "Panhandle Feeds for Beef Production." The experiment was carried out at the XIT Ranch, Channing, Tex., by J. J. Edgerton.

Some is sold on local markets for seed or for feeding purposes, but most of it is fed on the farms where grown.

## PRUSSIC ACID POISONING.

All kinds of sorghums, including Johnson grass, sometimes become poisonous through the formation of deadly prussic acid in their leaves, especially when their growth is checked by any cause, such as drought or frost. They are dangerous only in the green state and are harmless when cut and fully cured. The grain is never poisonous. The writers have heard of no cases of such poisoning from green milo, but this may be because, unlike sorgos and kafirs, it is almost never pastured.

## INSECT ENEMIES AND FUNGOUS DISEASES.

### INSECTS.

Milo has few serious insect pests. Chinch bugs are occasionally troublesome to this as to all other sorghums. Aphides, or plant lice, sometimes occur in great abundance on the leaves of young milo and other sorghums. When very abundant they tend to stunt the plants by sucking the juices from the leaves. The fall army worm[a] (*Laphygma frugiperda* S. & A.) sometimes does considerable damage to milo and other sorghums. The larva, or worm, of this moth is large, somewhat resembling the corn or cotton boll worm in size and color. The adult deposits its eggs in the unfolding upper leaves before they unroll. The injury done by gnawing back and forth through the tightly coiled leaf appears as a series of parallel rows of round holes in the expanded leaf. Such leaves are frequently lost by breaking off on a line of these holes. The nearly full-grown worm, especially of the later broods, is particularly fond of tunneling in the stem, 3 to 6 inches below the head, being protected by the sheath of the upper leaf. Frequently the stem is so weakened that it breaks in the wind and the young head droops over and dies, turning conspicuously paler. The worms occasionally enter the head itself, where they do more damage by fouling it with their excrement than by the quantity of grain actually eaten.

In southern and eastern Texas the larva of the sorghum midge (*Diplosis sorghicola* Coq.) prevents seed production by absorbing the juices from the young ovary so that the grain never develops. This is the trouble often called "blast" by farmers.

[a] A detailed account of the fall army worm is given in Bulletin No. 29, new series, of the Bureau of Entomology.

## FUNGI.

Milo is very free from fungi. It is especially noteworthy that it has never been known to be attacked by the kernel smut of sorghum, so destructive to most varieties. The head smut of sorghum also has never been found on milo.

## SUMMARY.

Milo is one of the durra group of sorghums, closely related to white durra ("Jerusalem corn") and to brown durra. It is probably of African, perhaps Egyptian, origin and was introduced into the United States between 1880 and 1886.

Milo is recommended as a short and suitable name for this crop. It is commonly known as dwarf milo, yellow milo, and milo "maize." The last name confuses it with corn.

There is only one variety handled by the seed trade. What is sold as "dwarf" milo is ordinary milo grown on the drier plains, where for lack of moisture it is low in stature. There is a true dwarf milo, but it is not yet generally sold on the market.

Ordinary milo stools freely at the base and branches freely above, is tall and rather stout, and is not uniform in height or in time or ripening. The heads are mostly pendent. As a crop it is difficult to handle rapidly and satisfactorily.

Improved or selected milo has to a large extent been prevented from suckering and branching, is low and rather slender, is uniform in height and ripening, and has its heads mostly erect. It may be handled easily by machinery and is fitted for harvesting with headers.

Milo is widely grown in western Texas and adjacent parts of New Mexico, Oklahoma, and Kansas. It is well suited to the entire southern half of the Plains region below 4,500 feet elevation. It can probably be profitably grown as far north as South Dakota and westward in Colorado and New Mexico to elevations of about 6,000 feet; likewise in the Great Basin region.

The soil requirements of milo are much the same as those of corn. The land should preferably be fall plowed and well prepared in spring to hold moisture and destroy weeds.

In general, milo should be sown about three weeks later than corn and after all danger from frost is past. Milo may be listed or sown at the surface as local conditions require. The seed is sown by means of special sorghum plates used in either the corn planter or the lister planter.

The best rate of planting for highest grain yields lies probably between 4 and 6 pounds to the acre, depending somewhat on the character of the soil, the average rainfall, the length of the season,

and the cultivation given. Four pounds to the acre has given the best results in the Texas Panhandle. The rows should be about 3½ feet apart and the stalks 6 to 8 inches apart in the row.

The cultivation of milo is essentially the same as that for corn.

Farmers should carefully select their own seed of milo, especially where it is not yet a staple crop. Selection is usually made for (1) earliness, (2) drought resistance, (3) higher yields, (4) uniformity, (5) freedom from suckers and branches, and (6) erect heads. The yield and value of the crop can be greatly increased by such means. Select enough for a small seed plat if time lacks for more extensive work. Interest the farm boys in this work.

Harvesting is usually done with a corn binder or by cutting the heads by hand. Ordinary milo can not be headed by machinery because of the pendent heads. Our improved milo with erect heads may be cut with a grain header or with a row header. A good adjustable kind of row header is much needed.

Thrashing is done with a grain separator. Slowing the cylinder and removing the concaves or part of the concave and cylinder teeth will prevent cracking the seed.

Yields vary from 25 to 55 bushels of seed to the acre. The yields in the Panhandle of Texas average about 40 bushels to the acre. As tillage methods and the crop itself are improved the yields should be increased.

Milo is used mostly as a feeding grain on the farms. It may be fed as thrashed grain, in the head or in the bundle. The grain is preferably cracked or ground before feeding, except for poultry. The heads may also be ground. Milo is entering more and more into the production of chops and poultry foods.

Milo, like other sorghums, may become poisonous in the green state, especially when checked or stunted in growth.

The principal insect enemies are the chinch bug, aphides or plant lice, fall army worm, and sorghum midge. The last may totally prevent seed production in the Gulf region.

Milo is entirely free from the kernel smut and the head smut of sorghum.

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